



REVIEW ARTICLE

Clinical Recommendations to Improve Utilization of Fissure Sealants in Primary Healthcare Centers in Bahrain

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Abstract

A situation analysis among which a cross-sectional survey of dental practitioners working in primary healthcare centers found that while 127 (94.8%) out of 134 respondents consider fissure sealants effective yet, most of them have misconceptions regarding which teeth to consider carious and which to seal as only 15 (11.2%) recognized that initial carious and non-cavitated carious lesions are the same and only around half sealed either. Fissure sealants are provided for free in primary healthcare centers, but they seem underutilized as only 35 (37.6%) dentists use them very often. To address these issues and others raised by dentists and dental hygienists on the indications and the use of fissure sealants; evidence-based clinical recommendations are provided keeping in mind the high level of caries among children and adolescents in Bahrain and the services provided in primary healthcare centers. Further studies will be needed to evaluate different reasons affecting dental practitioners' knowledge and use of fissure sealants as a method of preventing and controlling caries.

Keywords: Fissure Sealants, Non-cavitated carious lesions, Initial caries, High risk, Prevention, dentists, Dental hygienists

Abbreviations used in manuscript: Primary health care centers (PHCC), International Caries Detection and Assessment System (ICDAS)

Introduction

Dental caries are the most common noncommunicable disease worldwide.¹ It is a “diet-mediated” disease² as it is caused by free sugars.³ Dental caries are mainly prevented and controlled through the reduction of free sugars intake and ensuring optimal fluoridation of the mouth.¹

A method that has also been an established measure for preventing and controlling dental caries is sealing

pits and fissures of posterior teeth.⁴ This is done through the use of sealant materials; light-cured resin-based sealants are mostly used and are advised by multiple guidelines due to their effectiveness.⁵⁻⁸ Glass ionomer sealant is another material that can be used in certain circumstances, it has lower retention but good caries prevention properties.⁶

Pit and fissure sealants are effective in preventing and controlling caries in occlusal pits and fissures

as they penetrate and seal these anatomic groves creating a physical barrier that inhibits the collection of food particles and bacterial biofilm in these areas hence, preventing, and arresting caries progression.⁹

They are advocated to be used in the most susceptible areas for developing caries which are occlusal pits and fissures of posterior teeth. These surfaces have not shown the decline noticed in smooth surface caries. They are more prone to caries due to the anatomical features that favor plaque retention.⁴

Different updated versions of Cochrane reviews concluded that placing pit and fissure sealants on permanent molars reduces caries in children and adolescents up to 48 months when compared to no sealants.^{4,10,11} Also, fissure sealants reduce caries incidence in first permanent molars in children by 76.3% at four years when sealants were reapplied as needed.⁹

Pit and fissure sealants are part of comprehensive dental caries management,⁹ and pits and fissures are present in teeth other than first and second molars such as third molars, premolars, and palatal surfaces of incisor teeth, hence these surfaces can also be sealed as part of individual patient management.⁵

The importance of using fissure sealants in our population

Fissure sealants are effective in preventing occlusal caries in permanent teeth in high-risk individuals⁶ and populations with high caries prevalence.^{4,7,9-11}

Children and adolescents show high caries prevalence in our population. The last survey (unpublished)¹² showed that 88%, 56.4%, and 59% of six, twelve- and fifteen-years-old children respectively have dental caries which is comparable to other countries in the Eastern Mediterranean Region.¹³

The high caries prevalence indicates that the whole population is at high risk of developing caries¹⁴ and since fissure sealants are cost-effective in preventing caries in children and adolescents when the risk of caries is high⁸; the use of pit and fissure sealants is an important preventive strategy for our population.¹⁵

Pit and fissure sealants are provided in primary healthcare centers (PHCC) free of charge to citizens among other preventive and curative services.¹⁶

Due to the high caries risk and prevalence in the population, it is important to examine and analyze knowledge and utilization of fissure sealants in primary healthcare centers and provide recommendations accordingly. This is the first published situation analysis and clinical recommendations for the same in PHCC.

Situation analysis

Provision of pit and fissure sealants in primary healthcare centers

Pit and fissure sealants are provided by dentists in PHCC as part of individual case management. They are also provided by dental hygienists through the school-linked fissure sealants program in government schools.¹⁷ Since the early 1990's PHCC has provided a school-linked fissure sealant program in all primary government schools for second and third-grade children. Children with positive consent are brought by school bus to dental hygienists' clinics who examine children's four first molar teeth for eruption and the presence or absence of caries on the occlusal surfaces then they place fissure sealants on the first molars judged to have erupted enough to be isolated and are free of dental caries. Children diagnosed by dental hygienists to have carious molars are referred to dentists for operative treatment.

School-linked fissure sealant programs are among the best practices approach¹⁸ and are cost-effective.¹⁹ They increase access to services²⁰ as seen by a study in Kuwait which reported that children who were enrolled in the national school-linked preventive program had a higher number of sealed teeth compared to those not enrolled.²¹

While there is no published data on the school-linked fissure sealants program in PHCC, it was noticed that many of the first molars deemed carious by dental hygienists and referred for operative management were sound and could have benefited from the program.

results and discussion of a practice and knowledge survey

A survey on practice and knowledge was conducted among all 200 dental practitioners working in PHCC, out of which 134 (61 dental hygienists and 139 dentists) responded. Materials and methods, demographics, and other results are published elsewhere.²²

Of the surveyed dental practitioners 127 (94.8%) think fissure sealants are effective in preventing caries but only 15 (11.2%) were not confused about terminology and recognized that initial carious lesions are the same as non-cavitated carious lesions (Table 1), such confusion was also reported by Holmgren *et al.* in 2014.²³

Table 1 : Knowledge about fissure sealants (Total = 134)

n (%)	
<i>Are fissure sealants effective in preventing caries?</i>	
Yes	127 (94.8)*
No	7 (5.2)
<i>Is there a difference between initial carious lesions and non-cavitated carious lesions?</i>	
Yes	117 (87.3)
No	15 (11.2)*
Do not know	2 (1.5)
<i>Is it advisable to seal initial carious lesions?</i>	
Yes	73 (54.5)*
No	58 (43.3)
Do not know	3 (2.2)
<i>Is it advisable to seal non-cavitated carious lesions?</i>	
Yes	59 (44)*
No	72 (53.7)
Do not know	3 (2.2)

* Correct response

Regarding their management, only 73 (54.5%) thought it is advisable to seal initial carious lesions while only 59 (44%) thought it is advisable to seal non-cavitated carious lesions. This means that most dental practitioners considered teeth with initial carious lesions/non-cavitated carious lesions to be carious and would advise operative management.

A similar finding was seen in Greece,²⁴ where 80.1% of all surveyed dentists said they would not seal teeth with enamel initial caries and 53.5% would not seal surfaces with Questionable (colored/decayed) lesions. The opposite was seen in Yemen where 62.3% thought that sealants could be used in managing incipient lesions.²⁵

The survey also showed that 127 (94.8%) felt confident placing fissure sealants. On examining the frequency of sealants application 29 (70.7%) dental hygienists very often provided fissure sealants which is much higher than the dentists' percentage (table 2). This is understandable since dental hygienists provide fissure sealants in the school-linked program. That being said, a higher percentage would have been expected.

Table 2: Frequency of placement of fissure sealants

Qualification	Place fissure sealants		
	Never / Rarely	Occasionally	Very often
	n (%)	n (%)	n (%)
Dental hygienist	1 (2.4)	11 (26.8)	29 (70.7)
Dentist	17 (18.3)	41 (44.1)	35 (37.6)

From the same table, only 35 (37.6%) dentists provided fissure sealants very often which is considered low if the level of disease is taken into consideration. In comparison, it is better than

what was reported in Greece, where only 35.8% of general dental practitioners used them. Some of the reasons cited by those who do not use fissure sealants were lack of knowledge, the concern about sealing undetected caries, and the effectiveness of sealants.²⁴ The study also reported that when placing sealants, the majority of dentists did not follow a particular guideline, especially during teeth selection.

Underutilization was also seen in Scotland; Bonetti²⁶ in 2014 reported that several studies investigated this and concluded that different factors affected dentists' placing sealants, among which was outcome expectations. It was also reported in Florida in the United States of America, Govindaiah and Bhoopathi²⁷ reported in 2014 that even with a positive attitude about sealants, low knowledge was a finding that required dissemination of updated and evidence-based recommendations.

Other studies on sealants underutilization point to the need to increase knowledge about fissure sealants and advocate following known guidelines; Santos *et al.*²⁸ in 2020 found a positive correlation between knowledge and practice; when the knowledge about fissure sealants was enhanced, there was an improvement in their use in practice.

The survey's results are preliminary, but they indicate the current knowledge and practice of dental practitioners on fissure sealants as it shows that there is underutilization of fissure sealants and misconceptions regarding teeth selection.

Currently, no specific clinical guideline is followed by dentists in PHCC, and the guideline dental hygienists use has some issues including the need for evidence-based information. Also, varying concerns were raised on multiple occasions by dental hygienists about the application and follow-up of fissure sealants.

Recommendations

From the above findings, it is clear there is a need for clinical evidence-based recommendations to increase awareness and clear misconceptions about the effectiveness and the indications of fissure sealants in preventing and controlling caries in

molars, and to promote their use among dental practitioners.

The recommendations are based on updated and known fissure sealants guidelines and are presented and discussed taking into consideration that our population in Bahrain especially children and adolescents are all at high risk of developing caries. These recommendations also take into account the services provided and the materials used in PHCC.

Indications for pit and fissure sealants placement

Before discussing the indications for placing fissure sealants, it is important to discuss the accepted method of examining teeth, especially molars.

According to the World Health Organization,²⁹ International Caries Detection and Assessment System (ICDAS),³⁰ Irish Oral Health Services (2010),⁵ and American Dental Association Council,⁹ examinations for the presence of caries should only rely on visual examination of dry teeth.

The examination should be done under good light and after drying the teeth for five seconds. Sharp probes should not be used as they can cause irreversible damage by breaking enamel continuity, destroying the demineralized lesion, inoculating it with cariogenic bacteria, and creating favorable conditions for isolated lesion progression.^{9,31}

Radiographs can be used if available, but they are not advised for the sole purpose of placing fissure sealants.^{5,9}

i. Permanent molars

Fissure sealants are effective in preventing and controlling caries in first and second permanent molars in children and adolescents as advised by multiple guidelines.^{5-9,11,32}

Regarding primary molars, a recent Cochrane review³³ concluded there is insufficient evidence to support the use of fissure sealants to prevent caries in occlusal surfaces of primary molars. Also, a review with meta-analysis³⁴ concluded that there is insufficient evidence to verify whether sealants are effective in preventing or arresting initial caries in primary molars.

ii. Sound molars

Several guidelines advise the placement of fissure sealants in sound molars⁵⁻⁹ because they provide primary prevention as they inhibit the initiation of caries in them.^{8,9}

It is important to understand what is considered sound in molars. The color of pits and fissures in sound molars is not necessarily white. According to International Caries Detection and Assessment System (ICDAS)³⁰; Code 0 denotes sound tooth surface includes teeth with questionable change in enamel translucency after air drying for five seconds. It also includes surfaces with enamel hypoplasias, fluorosis, and molars with extrinsic or intrinsic stains. Hence the presence of stains does not indicate the presence of non-cavitated carious lesions/ initial carious lesions. Such teeth are recorded as sound and in populations with high caries prevalence and risk such as ours, such molars are indicated to be sealed.³¹

iii. Molars with initial lesions/ non-cavitated carious lesions

It was noticed in the survey, that the majority of dental practitioners thought the terms initial caries and non-cavitated caries differ from each other. They do not. Both terms refer to the same condition. According to the American Dental Association, "Noncavitated refers to initial caries lesion development before cavitation occurs" and such areas in the mildest form are only detectable after drying.³⁵

Pits and fissures with initial caries lesions do not look sound clinically (there are changes in color and translucency).³⁰ There is a change in glossiness and a clear change in color to brown with no underlying dark gray shadow which is a sign of dentine demineralization³⁵ and "The discoloration may be confined to the size of a pit or fissure or may extend to the cusp inclines to surround a pit or fissure."⁹

Similarly, according to ICDAS criteria, the appearance of non-cavitated lesions ranges from visual changes in opacity, or discoloration to a localized breakdown of enamel (without visual signs of dentinal involvement) seen in ICDAS codes 1, 2, 3. It also appears in code 4 as a dark shadow from

dentine (can be grey/blue/brown) with or without signs of localized breakdown in enamel³⁰ (Fig 1).

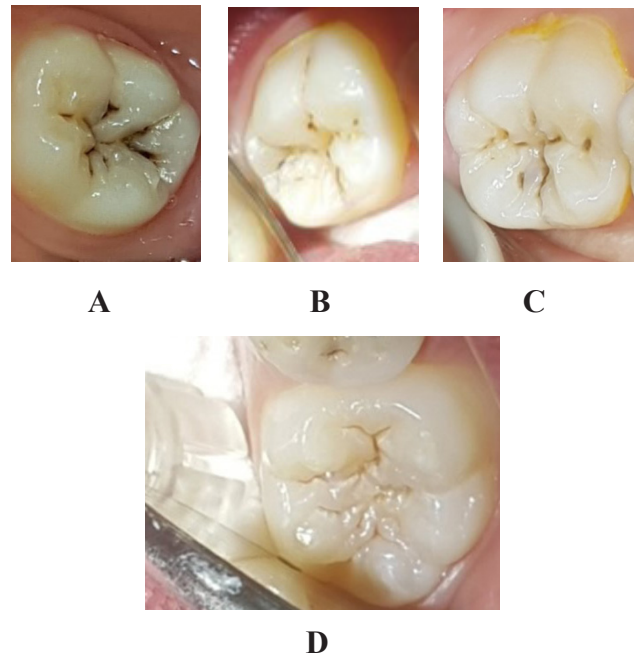


Figure 1. All these teeth can benefit from fissure sealants, regardless of the color of the pits and fissures.

The change in color in enamel is a visible sign of past disease that resulted from a history of imbalance between demineralization and remineralization and lead to mineral loss in such areas. Nevertheless, when the balance was restored; the caries process stopped but the color did not go back to what it was before.⁸

The placement of pit and fissure sealants over early or non-cavitated lesions provides secondary prevention. In this case, the sealants inhibit the progression of initial/non-cavitated carious lesions in children, adolescents, and young adults for as long as five years after placement. They isolate such lesions from surface biofilm (sugars, saliva, and bacteria) hence, prevent (arresting) caries progression^{8,9} and therefore are considered therapeutic.³¹

It is indicated to seal first and second permanent molars with non-cavitated lesions by Irish Oral Health Services Guidelines (2010)⁵ and American guidelines.^{8,9} Using ICDAS classification; Codes 1,2,3,4 are all indicated to be fissure sealed. Operative management is only indicated in ICDAS Codes 5-6 and that is when there is cavitation with visible dentine.³¹

It is considered unethical and unjustified to drill and perform an invasive treatment like an enamel biopsy or fissure investigation to treat non-cavitated lesions. The accepted strategy as a part of the non-invasive comprehensive management of patients is Bodecker's concept; "if in doubt seal".^{31,23}

In sealing non-cavitated lesions, the usual concern of dental practitioners is, will bacteria trapped below the fissure sealants cause the formation of caries and will the presence of sealants not allow the visualization of such cavitation and eventually caries will progress until it involves the pulp?

Several factors refute such concerns. First, fissure sealants act by forming a physical barrier that cuts the micronutrients of bacteria and there is no evidence that the number of bacteria or their viability increases under sealants.⁹ In fact, the mean number of viable bacteria was reduced in the sealed fissures by 100 to 1,000 fold⁵ and their viability was reduced by 50%.⁹ Also, the low levels of bacteria that might persist do not compromise the tooth.³¹

Second, even if a cavitation forms beneath the sealant, the sealant will break (Fig 2) because resin material is brittle (breaks easily) and because it has lost the supporting tooth structure beneath it³¹ it can be loosely likened to the occurrence of a sink hole.



Figure 2. Palatal fissure sealant broke when caries developed below it.

iv. As early as possible after molars eruption

Molars are very susceptible to developing caries during the eruption; hence timely prevention is very important. Fissure sealants should be placed as soon as isolation is possible and this does not mean waiting for the full eruption of molars (Fig 3) and it

is advised to review the placed sealants in this case after six months.⁵



Figure 3. The distal margin is in line with gingiva if isolation is possible, the tooth could be sealed without waiting for full eruption and the patient should be recalled for follow-up after six months.

In occasions where resin sealants cannot be applied due to difficulty in isolation (Fig 4) or due to lack of cooperation, glass ionomer sealants can be used⁵⁻⁸ but, since they are usually not available at dental hygienists clinics in PHCCs, it is advised to use fluoride varnish in such situations^{6,7,36} with follow up and reapplication according to patient's caries experience; every three or four months or bi-annually. When isolation is possible, fissure sealants can be applied.



Figure 4. Isolation might be difficult as seen in this image as the distal marginal ridge is below the gingival line. In this case, it is advised to place fluoride varnish and reapply it according to the child's caries experience and then to seal the tooth when isolation is possible.

A Cochrane review³⁷ did not find a difference in the performance of fissure sealants and fluoride varnish in preventing occlusal caries in permanent molars, but they found some evidence that applying fissure sealants as well as fluoride varnish may provide

better prevention than only applying fluoride varnish.

v. Other clinical situations where fissure sealants are advised

Holmgren *et al.*²³ in 2014 suggested the use of fissure sealants therapeutically to seal defective margins in old restorations as part of secondary prevention.

Keeping in mind the high risk of caries in our population especially children and adolescents and the need for prevention. There are instances when frank cavitation is adjacent to a discolored or a non-cavitated fissure, this does not preclude the use of fissure sealants. In such cases, the cavity is filled, and the adjacent fissure can be sealed (Fig 5).



Figure 5. Notice the cavity wall adjacent to the fissure; the discolored fissure is not carious and does not extend further in enamel. The cavity was eventually restored, and the adjacent fissure was sealed with a resin pit and fissure sealant.

Review and follow up on fissure sealants

The effectiveness of fissure sealants depends on their retention⁹ whether they were placed as primary or as secondary prevention.³¹

The concern that many dental hygienists voice is the fear that dislodged fissure sealants would put teeth at higher risk of caries formation under the remaining parts of the sealant. But, it has been shown that partial dislodgment of sealants does not put molars at higher risk of developing caries.^{5,31} Furthermore, even in cases where it is questionable if patients would return for follow-up, the benefit of placing sealants outweighs the risk of leaving teeth unsealed.³¹

Sealants should be reviewed at regular intervals and

recall visits. In general, the accepted recall interval for children and adolescents below 18 years old according to their caries experience is (3, 4, 6, and 12 months)³⁸ and sealants should be reviewed at such visits.⁶

Other than that, fissure sealants should be reviewed every six months if they were placed with questionable isolation (e.g.) not properly erupted molars or if placed over suspicious lesions.⁵

The assessment of fissure sealants on follow-up visits is done through both visual and tactile examination^{9,31} and when fissure sealants are found fully or partially dislodged (Fig 6), they should be resealed.^{5,9}



Figure 6. A partially dislodged fissure sealant was seen on a follow-up visit and requires resealing.

Placement of fissure sealants

Future research on sealants is expected to be on newer materials³⁹ and hence would probably lead to a change in techniques or steps. Since light cure resin-based fissure sealants as discussed earlier are advocated by multiple guidelines⁵⁻⁹ and it is the material used in PHCC, hence the placement of this material will be discussed.

The application of light cure fissure sealant although technique sensitive, yet simple.⁵ It generally involves, isolation of the molar intended to be sealed, etching and rinsing, and then applying the resin fissure sealant and light curing it. The application steps with various factors to consider are discussed below.

Operator

The success of fissure sealants depends on the individual operator and their skill rather than their type whether a dentist or a dental hygienist.^{5,32}

Four-handed versus two-handed technique

Placement of pit and fissure sealants is simple, but it should be done meticulously to ensure proper isolation.³² Hence, whenever possible four-handed dentistry should be employed to place fissure sealants as maintaining a dry field is simplified and retention is improved.^{5,9,32}

Isolation

In general, any method that provides proper isolation depending on the operator and patient can be used⁶ whether rubber dam or cotton rolls with effective aspiration.⁵ Mouth prop with high-volume suction can also be used.³²

If proper isolation is not possible it is advised to place fluoride varnish as mentioned previously and recall as appropriate.

Cleaning the tooth surface

Cleaning the tooth surface is not required before fissure sealants placement if the enamel surface is not covered by a considerable amount of plaque, as the acid etching will remove it.³¹ Otherwise, various methods can be used such as a dry bristle brush in slow handpiece or a dry toothbrush that can be used by a child or dentist^{5,6} or after supervised brushing for school children.³²

The use of pumice or prophylaxis paste is not required as it was not found to provide additive retention when compared to the use of a dry brush.⁵

Mechanical preparation

Mechanical preparation of enamel is not advised before fissure sealants.^{5,6,9} It is hard to understand the rationale behind cutting through the enamel to place a fissure sealant if the intention of placing it is to prevent and preserve.

Etching

The gold standard for achieving retention for resin sealants is etching and rinsing using 37% phosphoric acid⁶ The needed time for etching, rinsing, and drying should be as per the manufacturer's instructions of the used product.

Bonding

Currently, bonding before placing fissure sealants is not recommended.^{6,31}

Applying the sealant

After etching washing and drying the tooth, apply a minimum amount of sealant to adequately cover all pits and fissures. Applying the sealant using an instrument rather than a brush might reduce the risk of air bubbles.³¹ Bubbles and voids should be removed before curing.⁵

Curing and polymerization

Resin fissure sealants should be cured for the duration instructed by manufacturers. The light cure tip should be placed perpendicular and close as possible to the sealant and cured. In areas where more than one surface is sealed, e.g. occlusal and palatal fissures in upper molars and occlusal and buccal fissures in lower molars, each surface should be cured separately.⁵

In PHCC, Light Emitting Diode (LED) lights are used and are covered by transparent sheaths as part of the infection control protocol. A complaint was raised by some dental hygienists that when the transparent sheath is too close to the sealant material to be cured, the fissure sealant gets stuck to the sheath and then is pulled with it and away from the tooth surface when curing is over.

To prevent this and from a personal experience, it might be helpful to hold the light cure tip at a distance from the fissure sealant and cure it for a few seconds and then the tip of the light cure can be safely placed directly over the sealant and cured for the time instructed by the manufacturer.

Checking retention and occlusion

After curing, the sealant should be checked with a probe for retention and in case of lacking retention (the sealant comes off), the steps of etching and sealing are repeated. Occlusion should also be checked for possible high points and reduced accordingly.⁵

Final considerations

For caries prevention in our population, there is a need to reduce sugar intake and use optimal fluoridation, and to utilize fissure sealants.

Preventive, minimally invasive, and noninvasive dentistry should be part of holistic patient management. There is a need to appropriately

diagnose and recognize different colors/ shades of sound teeth; because sound teeth are not always white and it is advised that all children and adolescents in our population with sound or with initial lesions get fissure sealants as soon as possible after the eruption.

There is a need to promote the use of fissure sealants among dental practitioners in Bahrain and to further study the factors that affect dentists' placing fissure sealants, whether it's time, knowledge, or training and to address such accordingly.

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Conflict of interest

None reported

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